Stem cell fate dictated solely by altered nanotube dimension.

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Authors: Seunghan Oh, Karla S Brammer, Y S Julie Li, Dayu Teng, Adam J Engler, Shu Chien, Sungho Jin

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Public Summary:

Scientific Abstract:
Two important goals in stem cell research are to control the cell proliferation without differentiation and to direct the differentiation into a specific cell lineage when desired. Here, we demonstrate such paths by controlling only the nanotopography of culture substrates. Altering the dimensions of nanotubular-shaped titanium oxide surface structures independently allowed either augmented human mesenchymal stem cell (hMSC) adhesion or a specific differentiation of hMSCs into osteoblasts by using only the geometric cues, absent of osteogenic inducing media. hMSC behavior in response to defined nanotube sizes revealed a very dramatic change in hMSC behavior in a relatively narrow range of nanotube dimensions. Small (approximately 30-nm diameter) nanotubes promoted adhesion without noticeable differentiation, whereas larger (approximately 70- to 100-nm diameter) nanotubes elicited a dramatic stem cell elongation (approximately 10-fold increased), which induced cytoskeletal stress and selective differentiation into osteoblast-like cells, offering a promising nanotechnology-based route for unique orthopedics-related hMSC treatments.

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